

Environmental Adult Education for Mitigating the Impacts of Climate Change on Crop Production and Fish Farming in Rivers State of Nigeria

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Abstract

The threats of climate change to human society and natural ecosystems have become a devastating environmental problem for crop production and fish farming in Nigeria. This is partly because farmers and fisher folk are known to adopt age-old methods that do not counter current global warming and climate change effects. The purpose of this study was to establish through an empirical process the nature and degree of climate change impacts on crop production and fish farming and the environmental adult education programmes that would help crop farmers and fisher folk to mitigate the impacts on their occupational outputs. The descriptive survey research design was adopted for the study. 323 crop farmers and 433 fish farmers, representing 20% each out of the total populations of 1,623 and 2,191 members of crop farmers'/fisher folk's Cooperatives respectively in four local government areas were selected for the study through the proportionate sampling technique. Two research questions and one null hypothesis guided the study. Percentages, means and the T-test were the statistical methods used to analyse data obtained through a questionnaire. The results of the data analysis revealed that climate change led to reduction in variety of products and overall outputs, unpredictable times for crop/fish farming and harvest, as well as low incomes among other impacts. Based on the responses of the farmers, a number of environmental adult education programmes have been considered necessary to help the farmers mitigate the impacts of climate change on their occupational outputs. The researchers recommend, among other things, that with some assistance, relevant institutions in Nigeria should develop and implement the necessary environmental adult education programmes.

Keywords: Environmental Adult Education; Climate Change Impacts; Crop Production; Fish Farming.

1. Introduction

The impacts of climate change on crop production and fish farming constitute one major aspect of the most devastating environmental problems in Nigeria (Federal Republic of Nigeria, 2003). Rivers State is one of the States in Nigeria that are seriously suffering from the adverse effects of climate change on the environment. Crop farmers in Rivers State are experiencing an unpredictable rainfall which affects the growth of agricultural products like maize, okra, vegetables, cucumber, garden eggs. New diseases are affecting vegetables at such an alarming rate that is difficult to quantify (Ugwu, 2012). Climate change has really brought about a reduction in agricultural productivity. Floods are being experienced in many parts of Rivers State due to heavy rains. For example, the floods that occurred between July and September 2012 led to the destruction of lives and infrastructure. Lots of people were displaced and hectares of farm lands were submerged. Those who were affected lived in displacement camps for about three months (Mmom & Aifesehi, 2013).

Although climate change is a natural source of environmental degradation, some of such degradation is also caused by human (anthropogenic) activities (Eheazu, 2016a). Nigeria's Federal Ministry of Environment has outlined major factors responsible for climate change which include, among others, "inappropriate agricultural practices, such as bush burning and fuel wood extraction; the destruction of watersheds leading to siltation of rivers, soil erosion and loss of water courses" (Eheazu, 2011:59). Most farmers in Oyiibo and Ikwerre Local Government Areas of Rivers State engage in slash-and-burn and clean clearing of vegetation and application of inorganic manure for cropping which generate some greenhouse gases (such as carbon dioxide and nitrogen oxide) that promote climate change and its adverse effects.

Similarly, most fishermen in Okrika and Ogu/Bolo Local Government Areas of Rivers State engage in inappropriate methods of fish farming, such as the use of dynamites and other chemicals to catch fish. They also engage in deforestation of *Angala* (Rhizophora) vegetation for fire fuel to dry fish as a method of preservation. Many of the crop and fish farmers lack the necessary knowledge or awareness of the adverse effects of their practices on climate and, incidentally, their occupational productivity. The focus of this study was on determining through an empirical process what environmental adult education programmes would help the two groups of farmers to adopt environmentally friendly methods to mitigate the impacts of climate change on their occupation.

2. Literature Review

This review is aimed at explaining some concepts used in this research Report

2.1 Environment

According to Eheazu (2013), the natural environment of man on planet earth is segmented into four spheres; namely, the atmosphere (made up of gaseous layers), the hydrosphere (water, including oceans, seas and rivers); the lithosphere (soil of the earth's crust with underlying minerals), and the biosphere (containing living organisms like man, plants, wildlife, birds). In summary, Eheazu (2016b:1) sees the human environment as consisting of "all the external factors and forces with which individuals interact from conception to the grave".

2.2 Environmental Education

Environmental could be seen as education about, from and for the environment. Education *about* the environment focuses mainly on cognitive aspects. It is concerned with the acquisition of skills, knowledge and understanding of the environment and the related issues. It also concerned with discovering the nature of the area under study. It is crucial to perception and judgement. Education *from* the environment refers to the process of education that uses the environment as a medium for discovering and as a resource material for educational activities. It provides direct contact with the environment, gaining experiences, stimulating interest, as well as the relevant context for acquiring knowledge and developing skills. Education *for* the environment aims at the development of appropriate attitude and behaviour towards the environment. It goes beyond the acquisition of skills and knowledge and involves values and attitudes that affect behaviour. It is concerned with the formation of attitudes that leads to a personal environmental ethic in order for people to be involved responsibly in actions for the sound management of the environment and the protection of natural resources (Apel and Camozzi, 1996).

From the above definition, one would agree with UNESCO (1978) that environmental education is education aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work towards the solution.

2.3 Environmental Adult Education

Environmental adult education is a consciously organized environmental education for adults mostly outside the formal school system. This is why Slattery (2000) postulates that it is an applied education within the context of adult education to enable significant players (adults) in communities, groups and organizations organize and possess the necessary awareness upon which they take basic political action and to influence and educate others about their environment. The concept of environmental adult education took the centre stage when it was formalized by the International Union for the Conservation of Nature and Natural Resources (IUCN) in 1970 following its formal definition by William Bill Stapp in 1969 (Sato, 2006; Carmen, 1993). EETAP (1997) affirms that environmental adult education began as an outgrowth of conservation education.

According to Sumner (2003:39), Environmental Adult Education is recognized as a "hybrid outgrowth of the environmental movement and adult education, combining an ecological orientation with a learning paradigm to provide a vigorous educational approach to environmental concerns". In his own view, Eheazu (2013:24), sees Environmental Adult Education as "a product of the blend of the principles and goals of environmental education with those of adult education" and as a process in which adult individuals gain awareness of their environment and acquire the knowledge, values, skills, experience and determination which will enable them to act individually and collectively in harmony with the forces and elements that surround them, as they engage in their daily activities for survival.

2.4 Climate change and its impacts on crop production and fishery in Nigeria

The most general definition of climate change is a change in the statistical properties of the climate system over periods or decades or longer, regardless of cause (Houghton et al, 2001). The term sometimes is used to refer specifically to climate change caused by human activity. For example, the United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is, in addition to natural climate variability, observed over comparable time periods (UNFCCC, 1994). The Royal Society Science Policy (2010) observes that climate changes are caused by changes in the total amount of energy that is kept within the Earth's atmosphere. This change in energy, the policy explains, is then spread out around the globe mainly by ocean currents as well as wind and weather patterns to affect the climates of different regions.

Causes of climate change can be seen from two sources: natural processes and anthropogenic (human) processes. Examples of natural processes are volcanic eruptions, variations in Earth's orbit or changes in the sun's intensity. Human activities, on the other hand, can also cause changes to the climate; for example, by creating greenhouse gas emissions or cutting down trees in the forests. Global warming and the climate change

experienced today are being caused by the increase of carbon dioxide (CO₂) and other greenhouse gas emissions by humans which cause global warming. Climate change impacts on crop production and fish farming among other effects, include low productivity, loss in biodiversity, conflict/communal crisis and displacement of farming communities as witnessed in Nigeria these days in the conflicts between cattle grazers in search of pasture and local farmers.

3. Problem of the Study

Given the foregoing information on the topic of the present study, the need has arisen to determine and propose appropriate environmental adult education programmes needed by farmers and fisher folk to effectively mitigate the impacts of climate change on their productivity in Rivers State of Nigeria. To satisfy this need was the problem of this study.

4. Area of Study

This study involved four Local Government Areas of Rivers State of Nigeria; namely, Okrika, Ogu-Bolo, Oyigbo and Ikwerre. Rivers State which is one of the thirty-six states of the Federal Republic of Nigeria, is located at the serenity of Nigeria's South-South Geo-political region and is among the nine Niger Delta States of the country. It occupies an area of about 10,361 square kilometers with a projected population of 4,985,400. The state is bounded on the South and West by the Atlantic Ocean, and Bayelsa State respectively; to the North, it is bounded by Imo, and Abia States and on the East by Akwa Ibom State. The land part of the area has tropical rain forest. Towards the coast is a typical river delta environment which features many mangrove swamps. These features make crop production and fishery the main occupations of the people. Agricultural activities are grouped into crop production and fish farming (artisanal fishing). However, these activities experience low productivity in crop yield and fish catch due to the negative impacts of climate change on the environment.

5. Purpose and Objectives of the Study

The purpose of this study was to establish, through an empirical process, environmental education programmes that would assist farmers and fisher folk to mitigate the impacts of climate change on crop production and fish farming in Rivers State. Specifically, the objectives of this study were to:

- i) identify the degrees of impacts of climate change on crop production and fish farming as perceived by the affected crop farmers and fisher folk in Rivers State.
- ii) identify environmental adult education programmes relevant for mitigating the impacts of climate change on crop production and fish farming in Rivers State.

6. Research Questions (RQs)

Specifically, the research questions that guided the study were:

- i) What are the degrees of impacts of climate change on crop production and fish farming in Rivers State?
- ii) What environmental adult education programmes would assist farmers and fisher folk in mitigating the impacts of climate change on crop production and fish farming in Rivers State?

7. The Study Hypothesis (Ho)

Ho for the study posits that there is no significant difference between the responses of crop farmers and those of fish farmers on the degrees of impacts of climate change on their occupations (crop production and fish farming).

8 Design of the Study

The researchers adopted descriptive survey design which involved interpretation of existing conditions or relationships, opinions, on-going attitudes, prevailing practices, belief, effects that are being felt as well as current phenomena.

9. Population of the Study

The population of the study comprised 1,623 crop farmers and 2,191 fish farmers, making a total of 3,814 members of farmers and fisher folk Cooperatives in four local government areas (Okrika, Ogu-Bolo, Oyigbo and Ikwerre) of Rivers State. The breakdown of the respective populations is presented in tables 1 and 2 below.

Table 1: Distribution of Population of Crop Farmers

S/N	LGAs	Total number of cooperatives	Population of Crop Farmers in the Cooperatives
1	Okrika	4 cooperatives	101
2	Ogo-Bolo	-	-
3	Oyigbo	45 cooperatives	540
4	Ikwerre	82 cooperatives	982
Total	4	131	1,623

Source: *Fadama Records (Obio/Akpor LGA Head Quarters, 2015).*

Table2: Distribution of Population of Fish Farmers

S/N	LGAs	Total number of cooperatives	Population of Fish Farmers in the Cooperatives
1	Okrika	40 cooperatives	1,024
2	Ogo-Bolo	34 cooperatives	855
3	Oyigbo	19 cooperatives	228
4	Ikwerre	7 cooperatives	84
Total	4	100	2,191

Source: *Fadama Records (Obio/Akpor LGA Head Quarters, 2015).*

10. Sample and Sampling Technique

In order to obtain a representative sample for the study, 324 (farmers) and 439 (fisher folk) representing (20%) out of the total populations of 3,814 members of farmer/fisher folk Cooperatives in four LGAs were selected for the study. A proportionate sampling technique was adopted to ensure equal representation of the said samples among the LGAs. Tables 3 and 4 below show the sample sizes for the study in relation to the populations.

Table 3: Details of the Selected sample size of Crop farmers' population

S/N	LGAs	Total number of cooperatives	Population size	Sample size of population (20%)
1	Okrika	4cooperatives	101	20
2	Ogo-Bolo	-	-	-
3	Oyigbo	45cooperatives	540	108
4	Ikwerre	82 cooperatives	982	196
Total	4	131	1,623	324

Source: *Fadama Records (Obio/Akpor LGA Head Quarters, 2015).*

Table 4: Details of the Selected sample size of fish Farmers' population

S/N	LGAs	Total number of cooperatives	Population size	Sample size of population (20%)
1	Okrika	40 cooperatives	1,024	205
2	Ogo-Bolo	34 cooperatives	855	171
3	Oyigbo	19 cooperatives	228	46
4	Ikwerre	7 cooperatives	84	17
Total	4	100	2,191	439

Source: *Fadama Records (Obio/Akpor LGA Head Quarters, 2015).*

11 Instrument

The instrument for data collection in this study was a structured questionnaire developed by the researchers. The questionnaire was titled: "Environmental Adult Education Programmes for Climate Change Mitigation Questionnaire" (EAEPCCMQ). The questionnaire was structured on a modified four point Likert ratio scale as follows:

- Strongly Agree (4 points), Agree (3 points), Disagree (2 points), Strongly Disagree (1 point)
- Very High Impact (4 points), High Impact (3 points) Low Impact (2 points) Very Low Impact (1 point).

The questionnaire contained two sections, A and B. Section A focused on bio-data of respondents, while Section B focused on questions meant to provide information for obtaining answers to research questions and for testing the null hypothesis.

12. Data Collection and Analysis

The data was collected through the use of the questionnaire administered to the respondents with the help of four research assistants locally recruited and trained to explain in local dialects (where necessary) some items of the questionnaire to the subjects and to help reach out to crop farmers and fisher folk in remote areas. With the help of the research assistants, 763 copies of the questionnaire were administered to respondents. 756 copies (representing 99%) were returned. Statistical measures used to analyze data to answer various research questions

were based on response frequencies, means and the T-test. Since the items were rated on a four point scale (modified Likert-type), the criterion mean of 2.5 was used in taking decisions. Thus item responses that received a mean equal to or greater than 2.5 were considered to be positive, while items that scored below 2.5 were considered negative. The 2.5 criterion mean was arrived at by adding the weighted scale responses and dividing the total by 4 as in the example below:

$$\begin{aligned} \text{Mean } (\bar{X}) \text{ of responses} &= \frac{\text{Total sum of weights}}{\text{Total number of options}} \\ &\text{i.e. } \frac{SA+A+D+SD}{4} \\ &= \frac{4+3+2+1}{4} = \frac{10}{4} \\ &= 2.5 \end{aligned}$$

The hypothesis was tested using the T-test statistic at 0.05 level of significance.

13. Findings/ Results

13.1 Research Question One (RQ₁)

RQ₁ was meant to establish the degree of impacts of climate change on crop production and fish farming in Rivers State. Tables 5 and 6 below contain data used to answer RQ₁.

Table 5: Mean Responses by Crop Farmers on the degree of Impacts of Climate Change on Crop Production.

S/N	ITEMS Indicate the level of impact of climate change on:	CROP FARMERS' RESPONSES (N1=323)				TOTAL	MEAN (\bar{X}_i)	DECISION
		VHI=4	HI=3	LI=2	VLI=1			
1.	Poor crop variety production.	173 (692)	120 (360)	27 (54)	3 (3)	323 (1109)	3.43	High
2.	Irregular crop planting and harvesting seasons.	219 (876)	90 (270)	13 (26)	1 (1)	323 (1173)	3.63	V. High
3.	Loss in Gross National Product (GNP) and Gross Domestic Product (GDP) of the country.	114 (456)	198 (594)	9 (18)	2 (2)	323 (1070)	3.31	High
4.	Displacement of farming communities due to flooding from sea rises.	255 (1020)	49 (147)	16 (32)	3 (3)	323 (1202)	3.72	V. High
5.	Desertification which leads to reduction or/ extinction of some important crop species.	272 (1088)	34 (102)	13 (26)	4 (4)	323 (1220)	3.78	V. High
Pooled/Aggregate Mean (X₁)							3.58	V. High

Table 5 indicates that mean scores for items 1-5, depicting various areas and degrees of climate change impact on crop farming, were respectively greater than the criterion mean of 2.50. The pooled/aggregate mean X₁ (3.58) shows overall very high impact of climate change on crop farming. Severally too, very high impacts were recorded for irregular weather (item 2), flooding due to sea rises (item 4) and desertification (item 5).

Table 6: Mean Responses by Fish Farmers on the degree of Impacts of Climate Change on Fish Farming.

S/N	ITEMS What is the level of impact of climate change on:	FISH FARMERS' RESPONSES (N2=433)				TOTAL	MEAN (\bar{X}_i)	DECISION
		VHI=4	HI=3	LI=2	VLI=1			
1.	Production of poor fishing variety.	227 (908)	122 (366)	79 (158)	5 (5)	433 (1437)	3.32	High
2.	The migration pattern of fishes due to unpredictable weather.	257 (1028)	140 (420)	35 (70)	1 (1)	433 (1519)	3.51	V. High
3.	Loss in Gross National Product (GNP) and Gross Domestic Product (GDP) of the country.	156 (624)	264 (792)	11 (22)	2 (2)	433 (1440)	3.33	High
4.	Covering of low lying habitats where fishes reproduce their fingerlings due to climate-induced rise in sea levels.	307 (1228)	99 (48)	24 (48)	3 (3)	433 (1576)	3.64	V. High
5.	Exposure of fishes to ocean acidification due to destruction of mangroves (rhizophora) due to climate-induced sea rises.	360 (1440)	56 (168)	13 (26)	4 (4)	433 (1638)	3.78	V. High
Pooled/Aggregate Mean (X₂)							3.52	V. High

Table 6 above shows that mean scores for items 1-5, depicting various areas and degrees of climate change impact on fish farming, were respectively greater than the criterion mean of 2.50. Furthermore, very high impacts were recorded for unpredictable weather (item 2), rise in sea levels (item 4) and destruction of mangroves (rhizophora) due to climate-induced sea rises (item 5). The pooled/aggregate mean of 3.52 also shows overall very high impact of climate change on fish farming in Rivers State.

13.2 Research Question Two (RQ₂)

RQ₂ sought to find out the environmental adult education programmes relevant for mitigating the impacts of climate change on crop production and fish farming in Rivers State. Tables 7 and 8 below contain the data obtained to answer RQ₂.

Table 7: Mean Responses by Crop Farmers on Environmental Adult Education Programmes Relevant for Mitigating the Impacts of Climate Change on Crop Production.

S/N	ITEMS Considering your experience of the impacts of climate change on your crop farming, what is your opinion on the following items regarding their relevance to the reduction of the impact of climate change on your occupation?	CROP FARMERS' RESPONSES (N= 323)				TOTAL	MEAN	DECISION
		SA=4	A=3	D=2	SD=1			
1	Environmental awareness programme especially for illiterate farmers will help to reduce the impact of climate change on crop production.	279 (1116)	39 (117)	4 (8)	1 (1)	323 (1242)	3.85	Strongly Agree
2	Provision of non-formal and informal Climate change education programme will help farmers understand how their unhealthy farming practices foster climate change and its impact on crop production.	287 (1148)	34 (102)	2 (4)	0 (0)	323 (1254)	3.88	Strongly Agree
3	Provision of extension programme to expose farmers to appropriate farming methods and techniques for increase in food production even in the face of the impacts of climate change.	276 (1104)	41 (123)	6 (12)	0 (0)	323 (1239)	3.84	Strongly Agree
4	Conducting seminars/ workshops for farmers to improve their knowledge of the impacts of climate change and how to handle them.	273 (1092)	42 (126)	7 (14)	1 (1)	323 (1233)	3.82	Strongly Agree
5	Sponsoring demonstration programmes for farmers to learn the essence of afforestation and reforestation to reduce the impacts of climate change on crops due to excessive clearing of forests.	260 (1040)	54 (162)	9 (18)	0 (0)	323 (1220)	3.78	Strongly Agree
Pooled/Aggregate Mean (\bar{x}) =							3.83	Strongly Agree

Table 7 shows that all the mean scores (including the pooled/aggregate mean) are not only greater than the criterion mean of 2.50, but also show strong agreement with the items 1-5. In other words, the respondents strongly agreed that the various suggested environmental adult education programmes would be useful in assisting them to mitigate the impact of climate change on crop production.

Table 8: Mean Responses by Fish Farmers on Environmental Adult Education Programmes Relevant for Mitigating the Impacts of Climate Change on Fish Farming.

S/N	ITEMS In view of your experience, what is your opinion about the following as ways of helping you to reduce the impact of climate change on fish farming?	FISH FARMERS' RESPONSES (N = 433)				TOTAL	MEAN	DECISION
		SA=4	A=3	D=2	SD=1			
1.	Providing fish farmers with Environmental awareness programme (including basic literacy) to improve their methods of countering the effect of climate change on fish farming.	367 (1468)	61 (183)	4 (4)	1 (1)	433 (1660)	3.83	Strongly Agree
2.	Providing Climate change education programme to help fish farmers understand the impacts of their unhealthy fish farming practices that affect the climate system thereby changing their orientation for the better.	381 (1542)	50 (150)	4 (2)	0 (0)	433 (1678)	3.88	Strongly Agree
3	Providing agricultural extension programme to expose fish farmers to the appropriate fishing methods and techniques to reduce the impact of climate change and thereby increase their outputs .	324 (1296)	103 (309)	6 (12)	0 (0)	433 (1617)	3.73	Strongly Agree
4	Conducting workshops/seminars on how to cope with irregular time and tides for fishing in caused by climate change.	373 (1492)	44 (132)	15 (30)	1 (1)	433 (1655)	3.82	Strongly Agree
5	Setting up of demonstration farms for fisher folk to help them cope with changes in the location of fish due to climate change.	344 (1376)	80 (240)	9 (18)	0 (0)	433 (1634)	3.77	Strongly Agree
Pooled/Aggregate Mean (\bar{x}) =							3.81	Strongly Agree

As table 8 above shows, all the mean scores (including the pooled/aggregate mean) are not only greater than the criterion mean of 2.50, but also show strong agreement with the items 1-5. In other words, the respondents strongly agreed that the various suggested environmental adult education programmes would be very useful in assisting them to mitigate the impact of climate change on fish farming, as was the case of crop farmers in table 7 .

14. Test of Hypothesis (H₀)

The H₀ posits that there is no significant difference between the responses of crop farmers and those of fish farmers on the degrees of impacts of climate change on their occupations (crop production and fish farming). Mean responses of the subjects (including the pooled/aggregate means) in tables 5 and 6 above respectively are used to test the H₀, using the T-test statistic.

Using the standard deviation (SD) formula:

$$SD = \sqrt{\frac{\sum (\bar{x}_i - \bar{X}_1)^2}{N_1}} \quad \text{and} \quad \sqrt{\frac{\sum (\bar{x}_i - \bar{X}_2)^2}{N_2}},$$

i) The SD for table 5 data (SD1) = 0.022

ii) The SD for table 6 data (SD2) = 0.019.

Applying the SDs, data for t-analysis of the difference in aggregate mean responses in tables 5 and 6 (X₁ = 3.58 and X₂ = 3.52) is shown in table 9 below as follows:

Table 9: T-test of the significance of the difference in aggregate mean responses of crop farmers and fish farmers on the degree of impact of climate change on their occupations

N1	N2	\bar{X}_1	\bar{X}_2	SD1	SD2	df	t-cal	t-crit	P	Decision
323	433	3.58	3.52	0.022	0.019	754	1.30	1.96	0.05	Accept H_0

Using the formula:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{N_1SD_1^2 + N_2SD_2^2}{N_1 + N_2 - 2} \left(\frac{N_1 + N_2}{N_1N_2} \right)}}$$

the calculated t (t-cal) = 1.30, while the table t(t-crit) = 1.96 with degree of freedom (df) = 754 and the probability level of significance (p) = 0.05. The H_0 is thus accepted; i.e. there is no significant difference in the views of the crop and fish farmers on the degree of impact of climate change on their respective occupations.

15. Discussion

This study was aimed at establishing, through an empirical process, the nature and degree of impacts of climate change on the occupations of crop farmers and fisher folk and at identifying adult education programmes that would assist the farmers to mitigate the impacts.

15.1 Nature and degree of impacts of climate change on crop production and fish farming in Rivers State

The nature and degree of impacts are represented in tables 5 and 6 from the subjects responses in relation to RQ₁. Data in the two tables show that overall, both groups of farmers experience very high negative impacts on all the 5 items each group responded to with pooled means (\bar{X}_1 and \bar{X}_2) being respectively 3.58 and 3.52 against the criterion mean of 2.50. In specific terms, both groups of farmers commonly experienced high/very high negative impacts leading to poor variety of products, irregular patterns of harvest, loss in GDP/GNP and extinction of some species (of crops and fish) as a result of varying climatic conditions which led to, among other things, desertification or fish exposure to ocean acidification due to sea rises. Additionally, the crop farmers experienced displacement of their communities due to flooding, while the fish farmers experienced destruction (due to rise in sea levels) of low lying fish habitats that usually provided fingerlings which matured later for future fishing. The ultimate results of these impacts, obviously, was poor productivity/outputs from both the crop farmers and the fisher folk. It is no wonder then that the respondents agreed that climate change is lowering their contributions to both the Gross National Product (GNP) and the Gross Domestic Product (GDP).

15.2 Commonalty of the Perceptions/views of the farmers on climate change impacts

To further confirm the near similarity of the above discussed experiences of crop farmers and fisher folk, the researchers posited a relevant null hypothesis (H_0) that there is no significant difference (at $p = 0.05\%$) between the responses of the crop farmers and those of fish farmers on the degree of impacts of climate change on their occupations. Using the data in tables 5 and 6 to arrive at those in table 9, the t-test was performed to ascertain the significance of the difference between the means ($\bar{X}_1 = 3.58$; $\bar{X}_2 = 3.52$) in tables 5 and 6. The t-cal (1.30) was found to be lower than the t-crit (1.96). H_0 is therefore accepted at $p = 0.05\%$ level of significance (df = 754). This result very much confirms the commonalty of the experiences of the farmers and actually highlights the seriousness of the impacts of climate change on the occupations and outputs of the subjects of the study.

15.3 The Requisite Environmental Adult Education (EAE) Programmes

To ascertain the EAE programmes that would assist both crop farmers and fish farmers in Rivers State to mitigate the effects of climate change, data in tables 7 and 8 were obtained from the responses of the farmers to items on the questionnaire relevant to RQ₂. As in the case of data in tables 5 and 6, the responses of the two groups of farmers showed a lot of congruence with respect to the areas of the EAE they considered helpful for them to mitigate the impact of climate change on their occupational outputs. To begin with, the pooled/aggregate means in tables 7 and 8 (3.83 and 3.81) respectively showed overall strong agreement with the suggested five EAE programmes in each case. The individual programmes also received strong agreements from the two groups of farmers. In all, the two strongly agreed that the following EAE programmes would assist them to mitigate the impacts of climate change on their occupations and outputs:

- Creation of an environmental awareness programme (especially for illiterate crop farmers and fisher folk) on the real and deleterious impacts of climate change on their environments and occupations.
- Provision of climate change education programmes to, among other things, alert the two groups of farmers on how their unhealthy practices (deforestation, bush burning, use of chemicals for fishing,

- river pollution and so on) foster climate change and its impacts on their occupations.
- iii. Institution of agricultural/aquacultural extension programmes to expose the two groups of farmers to various methods and techniques for cushioning climate change effects and thus improve on their occupational outputs.
- iv. Organization of non-formal programmes (workshops, seminars and so on) on how to cope with changes in seasons for planting and harvesting, and changing patterns of tidal waves which frustrate location of preferred species of fish.
- v. Use of demonstration farms and fishing ponds to educate the farmers on the essence of adopting certain practices to reduce the impacts of climate change. For crop farmers, such practices would include conservation agriculture, use of newly developed strains of crops and so on. For the fish farmers, the practice would also include development of fish fingerlings in dug fishing ponds, conservation of rhizophora and so on.

16. Summary and Conclusion

The nature and degree of the impacts of climate change on crop production and fish farming in Rivers State of Nigeria have been clearly revealed by this study. The study has also shown the various environmental adult education programmes required by the crop farmers and fisher folk to mitigate the said impacts. There is every hope that if the programmes are properly implemented by relevant experts, the two groups of farmers involved in this study will experience a boost in their occupational outputs.

17. Recommendation

Given the obvious importance and urgency of implementing the requisite Environmental Adult Education (EAE) programmes discussed above, the researchers recommend *inter-alia*, that existing departments of adult and non-formal education with EAE units in Nigerian Universities (like that at the University of Port Harcourt) should collaborate with other Nigerian institutions responsible for crop and fisheries research to develop and provide the said EAE programmes. However, these university departments and the collaborating institutions would require support from their various superintending State and Federal Ministries of Education, Agriculture and Fisheries.

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